RECONNAISSANCE SOIL SURVEY OF THE SLAVE RIVER LOWLAND IN THE NORTHWEST TERRITORIES OF CANADA

by
J. H. Day and A. Leahey
Experimental Farms Service
CANADA DEPARTMENT OF AGRICULTURE
Ottawa, Canada.

1957

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SUMMARY

The Slave River Lowland in the Northwest Territories is the area covered with alluvial sediments through which the Slave River flows. The total area of the Lowland is estimated to be 2,179,000 acres, of which 2,056,000 acres are land and 123,000 are water.

Nine soil series and four land types were established during the course of the broad reconnaissance survey. The distribution of these soils and land types is shown on the map which accompanies this report (scale four miles equals one inch) by the use of fifteen soil associations or mapping units.

On the basis of soil characteristics it is estimated that about 73 percent of the Lowland is suitable for potential agricultural development. About half of this land consists of open meadows while the remainder consists of forest land. A considerable part of the forest land has been burned over and now is fairly open. However, many factors other than the quality of the soil must be considered before any area is developed for agriculture. The economic limitations of this area from an agricultural viewpoint are severe enough to preclude any extensive development at present. Nevertheless, the soils of the Slave River Lowland are a valuable resource and eventually will make a real contribution to the wealth of the Northwest Territories and of Canada.

ACKNOWLEDGMENTS

The authors wish to acknowledge the assistance and advice extended to them by officers of the Department of Northern Affairs and National Resources at Ottawa, Fort Smith and Fort Resolution. These officers did much to facilitate the field work in the best spirit of co-operation and we deeply appreciated their interest in our work.

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PREFACE

This soil survey was carried out at the request of the Interdepartmental Committee on Northern Agriculture* who desired to obtain information on the nature and extent of soils suitable for potential agricultural use lying within access of the Slave River in the Northwest Territories. No definite boundaries of the area to be covered were stated by the Committee but for several reasons the area examined and mapped was restricted to the silted-up part of a former southern arm of Great Slave Lake. This alluvial filled area has been designated in this report as the Slave River Lowland.

INTRODUCTION

In late June, 1955, the authors arrived at Fort Smith, N. W. T., where supplies were purchased and a 16-foot canoe and outboard motor was provided by the Department of Northern Affairs. An assistant, Mr. Jeremy Squirrel, was hired there for the field season. The survey party and its outfit was transported from Fort Smith to Grand Detour, a distance down-river of about 40 miles, aboard the M.S. Buffalo. At Grand Detour the survey equipment and supplies were portaged by Indian packers to the Little Buffalo river, a distance of about seven miles. The survey party arrived at the Little Buffalo River on July 1, and working northward reached the mouth of that river on July 13, and Fort Resolution on July 14. Here the canoe was replaced by a 24-foot skiff. The survey party then worked southward along the Slave River to Fort Smith. Altogether the survey party was in the area for 51 days from June 27 to August 16. The latter part of the survey was carried out by Mr. J. Day with the field assistant as Dr. Leahey had to leave the field on July 22.

No serious difficulties in travelling on the Little Buffalo and Slave Rivers were encountered although several stretches of shallow water on the Little Buffalo and high winds on the Slave caused some delay in the work. Mosquitoes were a constant source of annoyance during July and bulldog flies were bothersome when the temperature was above 65°F. The most unpleasant feature of travelling along the Little Buffalo River is that its water is rather distasteful owing to its salt content. Examination of the soils was carried out by foot traverses which were usually arduous owing to the tangled nature of the ground vegetation and the lack of trails.

*The Interdepartmental Committee on Northern Agriculture is composed of representatives from several Federal Government Departments interested in agriculture in northern Canada.

PART I

GENERAL DESCRIPTION OF THE AREA

Location

The Slave River Lowland is bounded on the south by the Northwest Territories - Alberta boundary, on the east by the Precambrian Upland, on the west by the Palaeozoic Upland and on the north by Great Slave Lake. The latitudinal boundaries are 60°N on the south side, 61° 31'N on the north side. The longitudinal boundaries are 111° 30' W on the east side and 113° 50' W on the west side. Roughly the Little Buffalo and Taltson Rivers form the western and eastern boundaries of the area while the Slave River flows through the central part.

Cultural Features

Settlement within the Lowland is limited largely to Fort Smith and Fort Resolution. Fort Smith is the location of the administrative offices of the Department of Northern Affairs, and has several stores, a hotel, post-office, hospital, two churches and two schools. Fort Resolution is the smaller center and has several stores, a hospital, two schools and a church. No other permanent settlement occurs in the Lowland although when the survey was conducted three logging camps were located on the Slave River at McConnell Island, Pointe Enneyeuse, and at Landry Creek.

Fort Smith and Fort Resolution are served by Canadian Pacific Airlines and by several charter airlines. Heavy freight is transported to the Lowland by river boats from the railhead at Waterways, Alberta, via the Athabaska and Slave Rivers.

Climate

Some climatic factors at Fort Smith and Fort Resolution are presented in Table I and may be compared with those at Hay River, Fort Simpson and Fort Vermilion. It will be seen that Fort Smith is the least favored location with a frost-free period of only 59 days, whereas Fort Resolution is the best with 93 days. However, Fort Smith has the greatest precipitation during the vegetative period with 7.6 inches, whereas Fort Resolution has the least with 5.3 inches. Fort Smith has the least water deficiency and Fort Resolution the greatest during the vegetative period.

TABLE I

Some Climatic Factors, Particularly Those Affecting Plant Growth, at Fort Smith, Fort Resolution, Hay River, Fort Simpson and Fort Vermilion

	Fort Smith, N.W.T.	Fort Resolution, N.W.T.	Hay River, N.W.T.	Fort Simpson, N.W.T.	Fort Vermilion, Alta.
North Latitude	60° 00'	61° 09'	60° 51'	61° 52'	58° 23
West Longitude	111° 52'	113° 40'	115° 46'	121° 21'	116° 03
Altitude above mean sea level	680 ft.	520 ft.	529 ft.	415 ft.	950 ft.
Mean annual temperature – degrees F.	25	23	24	24	27
Yearly Precipitation (inches)	13.0	11.6	11.8	13.0	12.1
Yearly rainfall (inches)	8.8	6.4	7.2	7.5	8.8
Beginning of vegetative period*	May 12	May 17	May 19	May 12	May 5
End of vegetative period	Sept. 22	Sept. 23	Sept. 25	Sept. 24	Sept. 25
Duration of vegetative period (days)	133	129	129	135	143
Mean date last frost in spring	June 18	June 10	June 11	June 4	June 13
Mean date first frost in fall	Aug. 16	Sept. 10	Sept. 7	Aug. 28	Aug. 17
Duration frost-free period (days)	59	92	88	85	65
Day degrees above 42° in vegetative period	1509	1311	1347	1725	1735
Total daylight in vegetative period (hours)	1830	2210	2160	2360	2340
Precipitation during vegetative period (inches)	7.6	5.3	5.9	6.8	6.8
Water deficiency during vegetative period (inches)	4.0	5.6	4.7	5.4	5.4
Days from beginning of vegetative period to drouth point	60	51	56	56	56
Mean date of drouth point	July 11	July 7	July 15	July 7	July 3
One inch rain changes drouth point by (days)	11	8	10	10	12
January daily mean minimum (degrees F.)	-25	-23	-25	-27	-24
Fuel consumption day degrees	15000	15300	15000	15000	14000

* Vegetative period is considered as the period during which the mean temperature is at or above 42°F.

The average dates of spring thaw and fall freeze-up of Slave River and Great Slave Lake are given in Table II.

TABLE II

AVERAGE DATES OF SPRING THAW AND FALL FREEZE-UP OF SLAVE RIVER AND GREAT SLAVE LAKE*

Free of ice in spring	
- Slave River at Fort Smith, 1952-1956	May 13
- Great Slave Lake at Fort Resolution, 1948-1956	June 7
Freeze-up in fall	
- Slave River at Fort Smith, 1953-1956	Nov. 12

*Meteorological Branch, Dept. of Transport

Permafrost

Field observations on mineral soils indicated that the Fort Resolution district is within the permafrost zone. The southern boundary of permafrost within the Lowland is judged to run from near the mouth of the Little Buffalo River eastward to the vicinity of McConnell Island and then eastward to the Taltson River.

Mineral soils in the permafrost zone tend to have a more dense and luxurious ground vegetation and a thicker moss cover than the Lowland soils free of permafrost, probably because there is more water available to plants. The depth to permafrost varies from six inches to two feet and is influenced by the depth of moss cover, soil texture, topographic position and summer precipitation. In burned-over areas the permafrost disappears and the soil surface often becomes irregular or humpy due to subsidence caused by melting of buried ice blocks.

The authors believe that two indicators of permafrost in the Lowland are fairly reliable. One is that within the permafrost zone the Slave River erodes its banks by undercutting, which leads to slumping. The slumped banks have a scalloped appearance on aerial photographs. The other indicator is negative, the permafrost area has virtually no aspen (Populus tremuloides) trees, whereas they are abundant elsewhere.

The occurrence of permafrost in the Lowland confirms the statement of Jenness* that the southern boundary of the true permafrost zone in Canada is the -5°C. isotherm for mean annual temperature. The mean annual temperature at Fort Resolution is -5°C., while that at Fort Smith is -3.9°C.

Vegetation

The Slave River Lowland is partly covered by mixed forest. There are extensive areas of open sedge-grass meadows (41%), a considerable area of marsh and slough (8%), and a number of burned-over forest areas which are covered by fireweed and small second-growth trees. It is estimated that upwards of 60 percent of the area is open or semi-open.

White spruce is the most common tree, followed by aspen, black poplar and willow. Pine is confined to porous sands near Fort Smith. White birch is more abundant on the permafrost soils with white spruce. Tamarack and black spruce are confined to poorly drained sandy and peat soils and are usually accompanied by groundbirch, labrador tea and sphagnum moss. Alder is found only on the lowest terraces of the rivers. The understory contains many species but the most noticeable are shepherdia (soapberry), rose, moss and grasses. Thick stands of fireweed occur on burned-over land.

The open meadows support a heavy growth of sedges and grasses. Many of these meadows are grazed by buffalo from Wood Buffalo Park.

The vegetation found on the various soils is described in the section on Soils, and a partial list of species occurring in the area is included at the end of this report.

Elevation and Topography

The Slave River at Fort Smith is 577 feet above mean sea level and the elevation of the west bank of the river here is 694 feet. The height of the river bank north of Fort Smith diminishes from 117 feet to about 50 feet at the Salt River estuary. From here northward to the delta the height varies from 15 to 30 feet. The elevation of Great Slave Lake is 512 feet. The gradient of the river north of Fort Smith is about one-half foot per mile.

The geodetic survey levels of the 60th parallel west of the Slave River reveal that the land due west of Fort Smith to the Salt River has a very gentle slope to the west. In other words, the Fort Smith elevation is 694 feet while

* Jenness, J. L., Permafrost in Canada. Arctic 2, 13-27. Sept. 1949.

the bank of the Salt River, 18 miles westward, has an elevation of 570 feet. This gradient of seven feet per mile is undetectable when driving over the country.

A cross section along the 60th parallel showing the elevations referred to forms a part of the soil map which accompanies this report.

The topography of the soil is gently undulating and level except where interrupted by steep slopes bounding terraces along the rivers. Abandoned stream channels are numerous throughout the Lowland.

Drainage

The Little Buffalo and Taltson Rivers roughly parallel, and in many places are, the western and eastern boundaries of the Lowland. They both are almost entirely fed from the adjacent plateaux rather than from the Lowland.

These rivers effectively prevent run-off from the plateaux from reaching the Lowland soils. In the case of the Palaeozoic Upland there are several saline springs along the escarpment. Solonchak soils have been observed in the vicinity of the new Salt River bridge* and near the confluence of the Nyarling and Little Buffalo Rivers.

No saline soils have been discovered east of the Little Buffalo River on the Lowland. The occurrence of saline soils along the Taltson River is not expected due to the nature of the rocks of the Precambrian Upland.

Drainage of surface water from the Lowland is slow due to the low gradient of the land. Present knowledge indicates that there are no perennial streams in the Lowland; however, shallow abandoned stream channels are numerous and are in part occupied by sloughs or by marshes.

Soil drainage is variable and depends on soil texture, nature of the substrata, and topographic position. Since the annual precipitation is relatively low, the soils are thought to be waterlogged for only a relatively short period during and after the spring thaw. Two exceptions to this case have been noted. The first is in the area west of the Little Buffalo River. Here the soils receive seepage waters from the adjacent Palaeozoic Upland and there are numerous extensive sphagnum peat muskegs and sloughs. The other exception is in the permafrost area. Permafrost prevents percolation

* Atkinson, H. J., R. F. Bishop and A. Leahey. "Studies on Strongly Alkaline Soils of the Salt River Plains in Northwestern Canada". Scientific Agric. 30: 30-37. Jan. 1950.

of surface waters through the soil. In this area the vegetation is more luxuriant, moss cover is thicker and sphagnum peat deposits are more common than in the area free of permafrost.

Geology

The Pleistocene geology of the Slave River Lowland has not been studied to any extent as yet. Geological information on the origin and nature of the surficial deposits appears to be limited to the reference by Camsell and Malcolm* that this area was a former arm of Great Slave Lake which has been silted up by material carried in by the Slave River. Therefore, the following comments on geology are to a considerable degree based on observations made in the course of the soil survey.

The Slave River Lowland in the Northwest Territories is a broad depression bordered by the Precambrian Upland to the east and the Palaeozoic Upland to the west. Geological maps show that the eastern portion of the Lowland is underlain by Precambrian rocks while the western portion is underlain by Palaeozoic rocks; the line of contact lying just to the east of the Slave River. At the close of the glacial period in this region Great Slave Lake covered this depression and extended over the adjacent uplands. The maximum height reached by Great Slave Lake in this area is not known but in the Hay River area to the west Leahey** found that the upper-most distinct beach associated with this lake occurred at an elevation of 870 feet. As the lake receded and the Slave River became established, the slopes of the adjacent uplands became wave washed and eroded while stone-free sediments were deposited in the bottom of the basin.

As far as could be ascertained from river bank exposures and soil pits, the Lowland is floored by a considerable thickness of sandy textured deposits. Around Fort Smith and Fort Resolution these sandy textured sediments come to the surface and form the parent materials for the Fort Smith, Norberta and Fort Resolution soils. In most of the Lowland, however, these sediments have been covered by varying thickness of finer textured sediments laid down by the Slave River and to a minor extent by the Little Buffalo River. Of particular interest is the widespread occurrence in the central part of the Lowland of a dark gray granular clay, which is the dominant parent material of the Slave, Grand Detour and Jean soils.

* Geological Survey, Canada: Memoir 108. The Mackenzie River Basin, 1921.

** Leahey A: Preliminary soil survey of lands adjacent to the Mackenzie Highway in the Northwest Territories. Canada Department of Agriculture Report. Mimeographed 1953.

The lower slopes of the Palaeozoic Uplands adjacent to the Lowland are characterized by very stony soils and stony wave-cut beaches with occasional exposures of bedrock. On some of the more gentle slopes the stony soil is covered with a few inches to a foot of sand. No doubt this stony soil is a glacial till but it was not possible to ascertain whether the fine material had been washed out of the till by wave action or whether the till had originally been composed of little more than rock rubble.

The Precambrian Uplands were not inspected by the survey team. However, aerial photographs indicated that a large percentage of the land adjacent to the Lowland consists of bare rock.

SURVEY METHODS

Soil examinations were limited largely to areas selected by prior study of aerial photographs rather than being carried out at regular and systematic intervals on lands adjacent to the Little Buffalo and Slave Rivers. These selected areas appeared to represent the major types of landscape patterns. From the information gained by the examination of the soils in the landscape patterns, the soil mapping units were decided on and by interpretation of the aerial photographs these mapping units were projected to the entire area of the Lowland.

Owing to difficulties in making foot traverses through this virgin country, all the areas examined were within a few miles of the Little Buffalo and Slave Rivers. The lands adjacent to the Taltson River, which runs along the eastern boundary of the mapped area, were not examined. However, the nature and origin of the soils on the Lowland leads the authors to believe that the soil map for this area has a fairly good degree of reliability at the broad reconnaissance level.

The soil map which accompanies this report is on a scale of four miles equals one inch. The scale of the map and the reconnaissance nature of the survey required that the soil series commonly found together be shown on the map as associations. Fifteen associations have been established on the basis of the kinds of soil and on the relative proportion of each soil within the association.

The descriptive legend on the map gives the main characteristics of each soil series. The association legend shows the soil series and/or land types found in each association, the proportion of each, the land pattern and acreage of each mapping association.

SOIL CLASSIFICATION

The soils of the Slave River Lowland have been classified into nine named soil series and four miscellaneous land types. The difference between the soil series and land type may be summarized by stating that the soil series is differentiated on the basis of soil characteristics entirely, while the land type is differentiated primarily on land form and secondarily in terms of soil material. The soil series is a group of soils having soil horizons similar in differentiating characteristics and arrangement in the soil profile and developed from a particular kind of parent material. In this survey the soil series was the lowest classification unit used. However, in a more detailed survey several of the soil series could have been subdivided into types and phases. Some of these subdivisions of the soil series are described in the report.

The term "variant" is used in this report to designate a soil distinctly different from any named soil series but because of its limited extent has not been named nor separated from the named soil series with which it occurs. Several such variants are described in this report. In a more detailed survey it would be possible to establish these variants as distinct soil series.

The mineral soils of the Lowland have a common origin inasmuch as they have all been formed from calcareous, stone-free, alluvial sediments. However, differences in soil texture, natural drainage, native vegetation, the occurrence of permafrost, and in age of the deposit, have resulted in the formation of various kinds of soils. The combined effects of these factors are expressed in the morphology of the soil profile and in its surface characteristics. Hence, a number of different soils occur on the Lowland despite their common origin.

The eight named mineral soil series of the Lowland, on the basis of characteristics expressed in the soil profiles, can be grouped into three major profile types or groups. These are the Brown Wooded, the Alluvial, and the Peaty Meadow groups. The general characteristics of these groups may be summarized as follows:

The Brown Wooded Group: These soils are well drained and have developed under a forest cover. Under a thin organic surface layer there is a brown or yellow-brown mineral horizon lying directly on light-gray calcareous parent material. The mineral horizons are low in organic matter. Weakly developed A_2 and B horizons may occasionally occur in the brown upper mineral layer.

The Alluvial Group: These soils are well or imperfectly drained and in this area are developing under a forest cover. Profile development is very weak. Free lime has been leached out of the upper part to depths ranging from two inches to two or three feet. The upper part of the mineral soil is usually darker in color than the parent material and usually contains a relatively high content of organic matter. These soils are very youthful and parts of them may be still subject to infrequent flooding by the rivers.

The Peaty Meadow Group: These are rather poorly drained soils which have developed dominantly under a sedge-grass type of vegetation. They have a thin peaty surface layer (less than 12 inches in thickness) over a dark colored mineral horizon moderately high in organic matter. Free lime may be present in the upper mineral soil but usually has been leached downward for a few inches. The lower mineral horizons are mottled and calcareous. The peaty surface layer appears to have been formed from sedges and grasses as sphagnum moss rarely occurs on these soils.

The Organic soils, i.e. soils where the organic surface layer is more than 12 inches thick, have been grouped into one series. These organic soils are composed of raw peat derived chiefly from sphagnum moss. Permafrost occurs at depths varying from 6 to 24 inches. They may either have a fairly level surface or occur as low concentric ridges around marshes.

A number of areas were classified into four miscellaneous land types. The recent alluvium is still being deposited by the Slave River at flood stage on the bars, low islands and low terraces and on the delta at the river mouth. This alluvium varies in texture from fine sandy loam to silty clay loam, but is calcareous throughout and shows no profile development. The eroded slopes are areas generally still subject to erosion. The marshes are covered with vegetation but are very wet areas. Stony land and rock outcrops occur in the Lowland but are entirely different in origin from the other soils and land types with which they are associated.

The soils of the Lowland and some of their principal characteristics are tabulated below. The miscellaneous land types are also listed.

A. Mineral Soils without Permafrost

1. Sandy soils		
a. well drained	Brown Wooded	Fort Smith
b. imperfectly to poorly drained	Peaty Meadow	Norberta

2. Loamy soils		
well drained	Brown Wooded Alluvial	Clewi Little Buffalo
3. Clayey soils		
a. well to imperfectly drained	Alluvial	Slave
b. imperfectly to poorly drained	Peaty Meadow	Grand Detour
B. Mineral Soils with Permafrost		
1. Sandy soils		
imperfectly drained	Alluvial	Resolution
2. Clayey soils		
imperfectly drained	Alluvial	Jean
C. Organic Soils with Permafrost		
poorly drained	Peat	Nyarling

D. Miscellaneous Land Types

1. Recent alluvium
2. Stony land and rock outcrops
3. Eroded slopes and river banks
4. Sloughs and marshes

DESCRIPTION OF THE SOILS

Fort Smith Soil Series

The Fort Smith is a Brown Wooded soil developed on sandy calcareous alluvial sediments. It occurs in the vicinity of Fort Smith on the banks of the Slave and Salt Rivers and also in association with the Norberta and Clewi series throughout the southern part of the mapped area. It covers about 49,000 acres. The topography is level to gently undulating, hence, natural drainage is good and surface runoff is low. The natural vegetation is mainly pine and aspen, with an understory of shepherdia, grass, rose, bearberry and fireweed. Much of the pine has been killed by fire.

The Fort Smith soil has the following general characteristics. Under a thin surface organic mat there may be one to two inches of brown fine sandy loam, under which there is usually two inches of weakly bleached sandy loam that is moderately to strongly acidic. The soil under the bleached layer is slightly to medium acid, brownish sandy loam or loam and when the bleached layer is absent this horizon extends to the surface. The structureless calcareous fine sandy loam parent material occurs at about 30 inches. The soil is porous, has low moisture-holding capacity and chemical analyses show that it is low in organic matter and nitrogen.

A profile, sampled two miles west of the road to Bell Rock, has the following characteristics:

Horizon	Depth	
1	1/2 - 0"	Very dark gray well-decomposed organic matter
2	0 - 2"	Brown (10 YR. 4/3 moist, 6/2 dry) fine sandy loam, weak granular, coherent and friable. Bulk density 1.06 pH 4.9.
3	2 - 4"	Grayish brown (10 YR. 5/2 moist, 7/2 dry) sandy loam, coherent, friable, compound very weak fine granular and single grain. This horizon is weakly bleached, lower boundary is clear and smooth. Bulk density 1.16, pH 4.9.
4	4 - 12"	Brown (10 YR. 4/3 moist, 5/4 dry) loam, very weak medium granular to single grain structure, coherent, friable. Bulk density 1.25, pH 5.5.
5	12 - 21"	Light olive brown (2.5 Y 5/6 moist, 6/4 dry) loam, compound single grain and very weak fine granular. Coherent, weakly mottled. Bulk density 1.20, pH 5.7.
6	21 - 27"	Light olive brown (2.5 Y 5/4 moist, 6/2 dry) fine sandy loam, weakly mottled, weak granular, coherent. The lower boundary is gradual. Bulk density 1.21, pH 6.4.
7	27 - 38"	Grayish brown (2.5 Y 5/2 and 5/4 moist, 6/2 dry) fine sandy loam, weakly mottled, weak granular, coherent, friable. Free lime is segregated in bands and nodules. pH 7.8.

A considerable range in profile characteristics occurs. Horizon 2 may be absent. Horizon 3, the weakly bleached horizon, is usually present and its color ranges from grayish brown to pinkish white. The depth to the limy parent material varies from about 22 inches to more than 48 inches.

Mottling may be present in the subsoil but usually is absent. Fires have had little effect on the soil other than to leave a little charcoal on the surface of the mineral soil.

Along the Slave River banks winds have deposited sand on top of the profile. The affected areas are very limited in extent.

Suitability for Agriculture

The Fort Smith soil has low moisture-holding capacity and low fertility, and is classed as arable with severe limitations for agriculture. For general farming this soil is unsuitable and probably its best use is for rough-grazing and as a source of fuel wood. However, it has the advantage of being an early soil and satisfactory yields of garden crops are obtainable with intensive management practices which must include irrigation and fertilization. The soil could be built up by incorporating peat hauled from the adjacent Norberta Series together with a nitrogen fertilizer which is needed to stimulate decomposition of the peat. A fertilizer containing both nitrogen and phosphorus is needed for general use on garden crops.

Norberta Series

The Norberta is a Peaty Meadow soil developed on sandy calcareous alluvial sediments. It occurs on both sides of the Slave River in the southern part of the mapped area and is associated chiefly with Fort Smith series and to a minor extent with Clewi, Grand Detour and Slave Series. It covers about 86,300 acres. The topography is level, but in relation to adjacent well-drained soils it is depressional. The natural drainage is poor, surface runoff is low and the soil probably receives spring runoff water from the higher Fort Smith soil. The native vegetation is mainly groundbirch, willow, moss, sedges and grasses, labrador tea, black spruce, tamarack and shrubby cinquefoil.

The Norberta soil has the following general characteristics. Under five to ten inches of well decomposed peat the loamy sand is highly mottled and contains free lime. The soil reaction is neutral to slightly alkaline. The moisture-holding capacity of the peat is high, but that of the loamy sand is low. The sand is porous but excess water in the soil is held up probably by a very impervious layer at some depth greater than four feet. The surface peat layer is high in organic matter and nitrogen.

A profile, sampled on the new road to Salt River, has the following characteristics:

Horizon	Depth	
1	0 - 8"	Well-decomposed dark reddish brown peat (5 YR. 3/2 dry). The lower boundary is abrupt and smooth, pH 7.1.
2	8 - 11"	Brown (10 YR. 4/3 moist, 2.5 Y 6/4 dry) loamy sand, single grained, coherent in situ, friable. Free lime is absent. pH 7.8.
3	11 - 24"	Dark yellowish brown (10 YR. 4/4 moist, 2.5 Y 6/4 dry), single grained loamy sand. There are streaks of organic matter through the horizon, and mottling is common. Coherent in situ, extremely limy. pH 8.1.

A considerable range in characteristics has been observed. The peat horizon ranges from five to ten inches in thickness. Some profiles have a dark organic mineral layer under the peat, while others have a somewhat bleached layer. The depth to the lime horizon varies from about six inches to more than three feet. Soil texture ranges from loamy sand to fine sandy loam.

A variant of the Norberta series is found in the imperfectly drained position. It has from four to six inches of sandy loam, high in organic matter, underlain by gray loamy sand which is highly mottled.

Another variant, not separated from the Norberta because of its small extent, was described and sampled on the old road north of the Salt River in a large sedge meadow-prairie area. The soil is considered to be an alkaline Thin Black.

Horizon	Depth	
1	0 - 4"	Very dark gray (10 YR. 3/1 moist, 3/2 dry) sandy loam plus gray sand grains. Friable, weak very fine granular structure. Bulk density 0.89 pH 6.5.
2	4 - 20"	Dark gray-brown (2.5 Y 4/2 moist, 6/2 dry) sandy loam, coherent, weak granular and friable. Mottles are few, fine and faint. Lime is absent. Bulk density 1.34, pH 8.4.
3	20" +	Light brownish gray (2.5 Y. 6/3 dry) weakly mottled fine sandy loam, friable. Moderately to strongly limy. Bulk density 1.47, pH 8.3.

The analysis of this soil is included in Table V.

Suitability for Agriculture

The Norberta soil has a high moisture-holding capacity in the peat but low capacity in the sand. It is moderately well supplied with organic matter and nitrogen but total phosphorus is probably low. The thick moss cover and peat retard warming up in the spring and help to maintain a high water table in the early part of the growing season. Clearing costs should be reasonable as the native vegetation consists of shrubs and a few scattered tamarack and black spruce. This soil should give fair yields of hay and coarse grains, but potatoes and other tender crops may not be adapted to this soil. Furthermore, this soil may be drouthy in very dry years. The soil is classed as arable with moderate limitations.

The imperfectly drained variant of Norberta referred to above, while very limited in extent, may have considerable value for gardens because it is moderately high in organic matter and nitrogen but is not subject to the cold wet spring conditions which prevail on the poorly drained Norberta.

Clewi Soil Series

The Clewi is a Brown Wooded soil developed on relatively thin, loamy calcareous alluvial sediments. It occurs north of the Salt River and on the east bank of the Slave River north of the mouth of Salt River. It covers about 5,400 acres. Fort Smith is associated with Clewi but occupies only a small percentage of the landscape. The topography is level to gently undulating, natural drainage is good and surface runoff is low. The native vegetation is chiefly aspen, black poplar, willow, white spruce with an understory of grass and shrubs.

The Clewi soil has the following general characteristics. Under a thin litter of leaves there are about two inches of dark brown loam high in organic matter and neutral in reaction. The next six-inch layer is brown, friable, moderately acid silty clay loam while the next 15-inch layer is yellow-brown, friable, slightly acid silty clay loam. The parent material is olive-brown calcareous silty clay loam and is underlain at an average depth of 28 inches by very porous calcareous sand. The soil has fairly good moisture-holding capacity, is very well supplied with organic matter, nitrogen and total phosphorus in the top two inches of mineral soil, but considerably less so below that depth. The content of available phosphorus is fairly high throughout the profile.

A profile, sampled on the old road north of Salt River, has the following characteristics:

Horizon	Depth	
1	1 - 0"	Leaf litter
2	0 - 2"	Very dark brown (10 YR. 2/2 moist, 3/1 dry) moderate fine granular loam, friable, bound together by roots. pH 7.0.
3	2 - 8"	Brown (10 YR. 4/3 moist, 7.5 YR. 5/4 dry) silty clay loam of weak very fine to medium granular structure. Friable. Lower boundary is smooth and gradual. Bulk density 1.13, pH 5.9.
4	8 - 23"	Yellow-brown (10 YR. 5/4 moist, 2.5 Y. 6/4 dry) silty clay loam. Massive but friable, weakly mottled, lime is absent. Lower boundary is smooth and clear. Bulk density 1.15, pH 6.0.
5	23 - 28"	Light olive-brown (2.5 Y. 5/4 moist, dry) silty clay loam, massive with white segregated lime. Weakly mottled, bulk density 1.18, pH 7.3.
6	28 " +	Light yellow-brown (2.5 Y. 6/2 dry) single-grained sand with disseminated lime. Coherent when moist, loose when dry. Weakly mottled, pH 8.0.

A range in characteristics has been allowed. The depth to sand varies from six inches to 36 inches, the average being about 28 inches. The depth to free lime varies from 18 to 30 inches.

Suitability for Agriculture

The Clewi soil is classed as arable with some limitations. Chemical analyses (See Table V) shows the upper two inches to be very well supplied with organic matter, nitrogen, total phosphorus and available phosphorus. Below that depth the mean values for nitrogen are about 0.07%, for organic matter from 0.9 to 1.5% and for total phosphorus 0.07%. While these values for the subsoil are not high, it is felt that the soil is moderately well supplied with nutrients. The subsoil is moderately acid. The soil is judged to have fairly good moisture-holding capacity. However, the sand which underlies the silty clay loam at an average depth of 28 inches tends to inhibit maximum root penetration and this soil may be subject to a hazard of drought in some years.

It is expected that this soil if cleared and cultivated will give fair yields of all crops which can be grown under the prevailing climatic conditions.

Slave Soil Series

The Slave is an Alluvial soil developed on relatively thin calcareous alluvial-lacustrine clayey sediments. It covers about 342,600 acres in the area between Salt River on the south, McConnell Island on the north, Little Buffalo River on the west and Taltson and Tethul Rivers on the east. It is associated with Grand Detour series which is developed on the same material, and with Little Buffalo, recent alluvium and sloughs. The topography is very gently sloping. The land pattern over most of the area is that of many irregularly shaped meadows (Grand Detour) separated by low ridges (Slave) but in part of the area, lying adjacent to the Slave River, the land pattern is roughly parallel ridges (Slave) separated by meadows (Grand Detour) and sloughs. Natural drainage is good to imperfect, and surface runoff is low. The native vegetation is chiefly spruce, aspen, black poplar, willow, birch, with an understory of shepherdia, rose, moss and grass. Merchantable spruce is found along the banks of the Slave River.

The Slave soil has the following general characteristics. Under a thin mat of living moss the soil is dark gray-brown to black moderately acid clay or silty clay loam which has well developed granular structure. The soil becomes less acidic with depth. The calcareous parent material is at an average depth of about 18 inches and the soil is underlain by sand at a depth of about three feet. The soil has very good moisture-holding capacity, is permeable, and is well supplied with plant nutrients.

A profile sampled on the east bank of the Slave River near Portage Island has the following characteristics. It represents most of the Slave soil series.

Horizon	Depth	
1	4 - 0"	Mat of living moss and grass roots.
2	0 - 4"	Very dark brown (10 YR. 2/2 moist, 3/2 to 5/2 dry) clay with strong fine to medium granular structure, friable to moderately firm. Lime is absent. Bulk density 0.89, pH 5.0.
3	4 - 10"	Black (2.5 Y. 2/0 to 10 YR. 2/1 moist, 10 YR 3/1 to 5/2 dry) clay with strong very fine to fine granular structure. Friable to moderately firm. Lime is absent. Bulk density 0.89. pH 6.1.

4	10 - 18"	Black (10 YR. 2/1 moist, 4/1 dry) clay with dark yellow brown mottles which are few, medium and fine. Structure and consistence as above. Bulk density 1.00. Lime is absent. pH 7.3.
5	18 - 20"	Clay as above with gray and yellow-brown mottling (10 YR. 3/1 and 5/4 moist).
6	20 - 26"	Gray (10 YR. 5/1 moist, 7/1 dry) silty clay with yellow-brown common coarse and prominent mottles. Bulk density 1.36. pH 7.6.
7	26 " +	Limy highly mottled silty clay. pH 7.8.

Another profile, sampled on Long Island, has the following characteristics, and represents the Slave soil found on the parallel ridge pattern near the Slave River.

Horizon	Depth	
1	3 - 2"	Root mat of moss, with needles and twigs.
2	2 - 0"	Black (10 YR. 2/1 moist, 2/2 dry) organic layer bound together by roots. Friable, lime is absent. pH 5.0.
3	0 - 8"	Very dark gray-brown (2.5 Y. 3/2 moist, 10 YR. 4/1 dry) silty clay loam showing bedding, plus two black (10 YR. 2/1 moist) organic layers which appear to be old surfaces. Friable consistence. Brownish yellow mottles (10 YR. 6/6 dry) are common, fine and prominent. Lime is absent. Bulk density 0.52. pH 6.1.
4	8 - 20"	Very dark gray-brown (2.5 Y. 3/2 moist, 2.5 Y. 6/2 dry) silty clay loam showing bedding. Friable to firm, lime is absent. Bulk density 0.81. pH 6.6.
5	20" +	Frozen, believed to be the current year's frost.

A profile similar to the one described above was sampled at Brulé Point in 1945 by Leahey.

Horizon	Depth	
1	3 - 0"	Living moss.
2	0 - 8"	Dark gray clay. Lime is absent. pH 6.4.
3	8 - 14"	Gray clay, somewhat mottled. Lime is absent. pH 6.6.
4	14 - 19"	Compact iron stained clay. pH 7.5.
5	19 - 23"	Compact light-gray clay, somewhat iron stained. Moderately limy, pH 8.0.

A range in characteristics has been allowed. The clayey parent material is usually underlain by sand at depths of three feet or more but on the southern end of the area the depth to sand may be only 12 inches. The depth to free lime varies from 16 to 26 inches, and soil structure ranges from strong granular to massive.

A variant of the Slave soils is sometimes found on the highest knolls along the banks of the Slave River. The horizon under the organic mat is brown or yellow brown while the other horizons are dark gray or black. This variant may belong to the Brown Wooded soil group.

Burning of the forest on the Slave soils generally has little effect on the soils beyond destroying the surface organic layer.

Suitability for Agriculture

The Slave series is judged to have high soil moisture-holding capacity. The strongly developed granular structure contributes greatly to a moderate permeability. The subsoil horizons show some swelling and shrinking with changes in soil moisture supply. In general the physical soil properties are judged to be good and a deterioration of soil structure on cultivation is not expected.

Chemical analyses (See Table V) show that soil reaction ranges from moderately acid at the surface to slightly alkaline in the parent material. The organic-matter content of the surface litter is about 35%; of the surface mineral soil 7 to 16%. Nitrogen values range from 0.3 to 0.5% in the surface mineral soil. Total phosphorus values are 0.06% in the surface and range from 0.07 to 0.09% in the parent material. These analyses indicate that the soil is well supplied with plant nutrients.

The density of forest cover is variable. Some areas have recently been burned over, leaving a tangled mass of tree trunks and stumps, with fireweed and second growth well established. Virgin areas on the smooth landscape usually have trees with diameters up to 12 inches. However, on the parallel-ridged landscape, particularly on the banks of the Slave River, spruce trees with diameters up to 36 inches and mature black poplar up to 16 inches in diameter are found. Thus it is difficult to generalize as to clearing costs on this soil, except to say that the cost may be very high in some places.

The Slave soil is considered to be very desirable for agricultural use and hence is classed as arable. The best locations, with the best drainage, are to be found on the highest banks along the Slave River. The lower terraces along the river have good drainage in general but may occasionally be flooded and for that reason are rated as less desirable. On these locations vegetable crops, including potatoes and early maturing vegetables, could be grown. The soil away from the river banks, where drainage is slightly poorer and where the hazard of early frost is perhaps somewhat greater, is probably best suited to cultivation of hay, coarse grains, and perhaps forage seed crops.

Grand Detour Soil Series

The Grand Detour is a Peaty Meadow soil developed on relatively thin calcareous alluvial-lacustrine clayey sediments. It covers 894,000 acres in the area between Salt River on the south, Great Slave Lake on the north, and the Uplands on the east and west. It is associated with, and developed on the same parent material as, the Slave series and the Jean series, which is the permafrost analogue of the Slave series. Small sloughs and recent alluvium also are associated with the Grand Detour. The topography is level or depressional in comparison with the Slave or Jean series. Natural drainage is imperfect to poor and surface runoff is very low. The native vegetation is mainly sedges, grasses, rushes and a variety of forbs which include silverweed, marsh hedge-nettle, avens, and mint. Willow and ground-birch may occasionally be present in scattered clumps or as continuous cover. Large open meadows are typical of the Grand Detour series.

Under natural conditions the soil has the following general characteristics. Under three to ten inches of poorly decomposed moderately acidic sedge peat the subsoil is weakly mottled granular to massive clay which is moderately acidic. The depth to the calcareous parent material from the top of mineral soil is about 12 inches and there is a calcareous sandy base at a depth of about two feet. The soil is well supplied with organic matter, nitrogen and phosphorus. Soil moisture-holding capacity is good and the sandy layer at the base of the profile alleviates the tendency to poor drainage. There is no permanent water table within the upper few feet. This is probably the reason why moss peat (muskeg) did not develop on these sites.

A profile, sampled on Grand Detour portage trail about one mile east of Little Buffalo River, has the following characteristics:

Horizon	Depth	
1	12 - 4"	Very dark grayish brown (10 YR. 3/2 moist or dry) raw sedge peat. Bulk density 0.42, pH 5.5.
2	4 - 0"	Black (10 YR. 2/1 moist, 3/2 dry) muck bulk density 0.27. pH 5.8.
3	0 - 8"	Black (10 YR. 2/1 moist, 5 Y. 5/1 dry) silty clay of massive structure and friable to firm consistence. Slightly mottled, bulk density 0.89, pH 6.0.
4	8 - 16"	Very dark brown (10 YR. 2/2 moist, 3/1 dry) silty clay of weak fine nuciform structure and friable to firm consistence. Slightly mottled. Bulk density 0.64. pH 5.4.
5	16 - 22"	Dark gray-brown (10 YR. 4/2 moist, 2.5 Y. 6/2 dry) clay loam parent material, friable, has shells embedded and contain free lime. pH 7.6.

Horizon 4 is very high in organic matter and probably is a buried soil surface.

The above described profile had a greater thickness of peat and free lime was lower than in any others examined and classified as Grand Detour. Another profile, sampled about one quarter mile east of the Little Buffalo River and just north of the mouth of the Nyarling River, appears to represent the near minimum thickness of peat and the minimum depth to free lime found in these soils under natural conditions.

Horizon	Depth	
1	5 - 0"	Very dark gray (10 YR. 3/1 dry) muck bound by roots, fibrous. pH 6.3.
2	0 - 10"	Dark gray (10 YR. 4/1 moist, 6/1 dry) silty clay. Sticky and plastic when wet, very hard when dry. A few yellow-brown mottles, moderately limy. pH 7.8.
3	10" +	Dark yellow-brown and dark gray (10 YR. 4/4 and 4/1 moist, 2.5 Y. 6/0 dry) silty clay loam. Massive, friable, hard when dry. Micaceous minerals are present. Olive yellow mottles (2.5 Y. 6/6 dry) are many, fine and prominent. Moderately limy. pH 7.6.

Burned-over profiles of the Grand Detour are frequently encountered. The most noticeable difference in the profile is the thinner peat horizon, and the presence of charred willow and spruce stumps on the margin of the meadow.

A profile sampled east of Long Island which had been burned over had the following characteristics:

Horizon	Depth	
1	3 - 0"	Well-decomposed peat, very dark gray-brown (10 YR. 3/2 moist and dry) friable. Bulk density 0.13, pH 6.3.
2	0 - 3"	Black (10 YR. 2/1 moist, 3/1 dry) strong, very fine granular clay. Bulk density 0.40, pH 7.2.
3	3 - 5"	Black (10 YR. 2/1 moist, 5/1 dry) clay. Strong very fine granular structure, friable, moderately limy. Mottles are few, fine and faint. pH 7.8.
4	5" +	Dark gray (7.5 YR. 4/0 moist, 10 YR. 5/1 dry) clay, very strong fine granular structure. Mottles are few, medium and fine. Friable when moist, hard when dry. Extremely limy. Bulk density 0.93, pH 7.6.

Very occasionally all of the surface peat has been removed by fire.

Some of the Grand Detour soils in Soil Association 9 have been subject to recent flooding by the Slave River as evidenced by silt deposits on the surface. However, the areas of Grand Detour soils in other Associations do not appear to be now subject to this danger although they may in part be temporarily flooded for a short time by spring runoff.

The above profile descriptions indicate that some variation in thickness of peat, state of decomposition, depth to free lime and other characteristics has been allowed in this soil series.

Suitability for Agriculture

The Grand Detour series is classified as arable with some limitations. The areas of this soil constitute a large part of the range over which buffalo from Wood Buffalo Park graze. This soil is reported to be wet in the spring for the relatively short period during which the winter snow is thawing. Spring floodwaters from the rivers affect only a very small percentage of the soil, as indicated by the absence of recent silt deposits on or in the profile. Throughout the summer the soil surface is dry, the subsoil is moist, and footing for grazing buffalo is good.

Chemical analyses (See Table V) shows that the soil is well supplied with nitrogen, organic matter and phosphorus. Soil reaction is moderately acid, except for the parent material which is slightly alkaline.

The physical properties of the soil are favorable, in that the peat is shallow and could be incorporated into the underlying mineral soil. Soil moisture-holding capacity is good, and the sandy substrata below the parent material promotes moderately good internal drainage. Furthermore, the occasional abandoned stream channel could be used to improve surface drainage.

Clearing costs will be very low. Willow clumps, which in some areas cover a fairly high percentage of the soil surface, might in most cases be plowed under in the initial breaking operation. During plowing it would be desirable to incorporate a few inches of the mineral soil into the peat.

Crops which could be grown on this soil are hay and coarse grains. The danger of early frost precludes potato crops and probably grass and legume seed crops.

For suitable crops this soil is considered to be potentially one of the best in the Lowland.

Little Buffalo Soil Series

The Little Buffalo is an Alluvial soil developed on loamy calcareous sediments of alluvial origin. It covers 12,600 acres and occurs as narrow discontinuous levees and terraces of the Little Buffalo River. It is associated with the Slave series. The topography is gently undulating to level, natural drainage is good to imperfect and surface runoff is low. The native vegetation consists mainly of spruce, aspen, black poplar, willow, alder and birch with an understory of shepherdia, rose, red-osier dogwood, lyme grass, dog couch grass, foxtail and sedge. Some of the spruce on the levees of the Little Buffalo River is of near-merchantable size.

The Little Buffalo soil has the following general characteristics. There is a thin surface accumulation of moss and woody litter. The mineral soil is a very dark gray-brown loam and light clay loam, which is fairly uniform to the light gray marly silty clay parent material. The soil is granular, friable, and is free of lime to the parent material which usually is at a depth of 20 inches. The soil moisture-holding capacity is high, the soil structure is good, and it is very well supplied with plant nutrients.

A profile sampled near the lower rapids on the Little Buffalo River has the following characteristics:

Horizon Depth

1	1 - 0"	Fibrous accumulation of needles and moss.
2	0 - 6"	Very dark brown to gray-brown (10 YR. 2/2 to 5/2 dry) loam, friable and very weak fine nuciform structure. Bound together by roots. Bulk density 0.36. pH 6.3.
3	6 - 12"	Very dark gray-brown to light brownish gray (10 YR. 3/2 to 6/2 dry) friable light clay loam. Structure is very weak fine nuciform. Bulk density 0.69. Free lime is absent. pH 6.9.
4	12 - 18"	Very dark gray-brown to gray-brown (10 YR. 3/2 to 5/2 dry) friable light clay loam. Structure is compound very weak fine granular and nuciform. The organic matter content is high and the bulk density is 0.61. Free lime is absent pH 7.2.
5	18 - 20"	An old surface horizon chiefly of wood. Free lime occurs below a depth of 19 inches.
6	20 - 26"	Light gray (10 YR. 6/1 dry) marly silty clay with white specks of lime scattered throughout. Friable, bedded. Bulk density 0.87. pH 7.3.

Soil characteristics which are variable are the texture and depth at which free lime occurs. The texture varies from fine sandy loam to heavy loam. The degree of organic matter accumulation is variable. Generally the profile has a fine textured horizon at depth.

Suitability for Agriculture

The Little Buffalo series has weakly developed soil structure and the high porosity is due to the high organic-matter content. Soil moisture-holding capacity is fair to good and the permeability is moderate.

Chemical analyses (See Table V) reveal that this soil is very well supplied with organic matter, nitrogen and phosphorus. In fact it is about the most fertile soil in the Lowland area.

The native vegetation on this soil is moderately heavy and it is estimated that clearing costs would be moderately high. However, a number of factors outweigh that disadvantage.

The advantages of the Little Buffalo soil lie in the very favorable physical and chemical soil properties; in the fact that when the forest is cleared off, good air drainage would be promoted by the position of the soil chiefly on

levees of the Little Buffalo River; in that it is early; in the good natural soil drainage which prevails; and in the relatively good accessibility provided by the Little Buffalo River.

The Little Buffalo series is considered the best in the Lowland for production of vegetable crops.

Resolution Soil Series

The Resolution is an Alluvial soil developed on sandy calcareous sediment and when forested has permanently frozen subsoil. It covers about 67,200 acres in a wide band of land adjacent to the shoreline of Great Slave Lake. It is associated with the Jean series, with Nyarling peat and sloughs and marshes. The topography is gently undulating, natural drainage is imperfect and surface runoff is low. The native vegetation is dense and seems more luxuriant than in areas free of permafrost. Also the moss cover is thicker. The principal species are spruce, birch, black poplar, and willow. The groundcover consists of moss, shepherdia and bearberry.

The Resolution has the following general characteristics: There is a thick organic mat over a moderately thick mineral-organic horizon which is very dark brown to brown. The subsoil is gray loamy sand which is increasingly mottled with depth. Permafrost is encountered between 10 and 30 inches deep. Moisture-holding capacity of the peat is high but low for the sand. The sand is porous but downward movement of water is inhibited by the permafrost.

A profile sampled 1 1/2 miles east of Resolution airport has the following characteristics:

Horizon	Depth	
1	5 - 0"	Very dark gray (10 YR. 3/1 dry) organic material bound together by roots. pH 6.3.
2	0 - 5"	Very dark brown (10 YR. 2 2 moist, 10 YR. 4/2 dry) granular friable sandy loam, high in organic matter, speckled with white sand grains. Lime is absent. pH 7.0.
3	5 - 10"	Light gray (10 YR. 7/1 moist, dry) coarse loamy sand of single-grained structure, coherent in place, loose when dry. Low in organic matter except for occasional thin streaks of woody material. Yellow-brown mottles (10 YR. 5/6 moist) are few, medium and prominent. Free lime is absent. pH 7.3.

4	10 - 13 1/2"	Light gray sand (10 YR. 7/1 moist, 2.5 Y.6/2 dry), coherent when moist, loose when dry, free lime is absent. Yellow-brown mottles are few, fine and faint. Frozen at 13 1/2 inches. pH 7.3.

Another profile sampled about three miles upstream from the Little Buffalo River mouth has the following characteristics:

Horizon Depth

1	7 - 3"	Peat moss. pH 6.2.
2	3 - 0"	Dark reddish brown (5 YR. 3/2 dry), well decomposed peat, pH 7.5.
3	0 - 2"	Light brownish gray (10 YR. 6/2 dry) moderately friable, sandy loam. pH 7.4.
4	2 - 4"	Light olive-brown (2.5 Y. 5/4 dry) sand, extremely friable with weak crumb to single grain structure. pH 7.6. Frozen below.

The thickness of living moss varies from two to six inches and there may be a layer of semi-decomposed moss or peat below. The mineral soil is variable in organic content. The upper mineral horizons are usually non-calcareous while the lower ones are strongly calcareous.

Buried soil surfaces may be present. The depth to permafrost varies from 10 to 30 inches, depending on the thickness of the moss cover.

When severely burned the surface organic layers have been removed leaving the gray sand exposed. Such soils are free of permafrost to depths greater than four feet and do not have the humpy topography that is present in the Jean burned-over soil. The reason for this probably lies in the low moisture-holding capacity and low ice content of the sand.

Suitability for Agriculture

Under natural conditions the Resolution series has high moisture-holding capacity in the peat but low capacity in the sand. The sand is porous but downward movement of water is inhibited by the permafrost. The combination of thick water-saturated moss and peat on the soil surface together with impeded internal drainage leads to a cold wet soil which is slow to warm-up in the spring. Chemical analyses (See Table V) indicate that the soil is well supplied with organic matter, nitrogen and total and available phosphorus. However, the organic material is coarse and raw.

When this soil is cultivated the permafrost level is markedly lowered. This results in the soil becoming drouthy. For general agriculture it is classed as arable with severe limitations. However, it is of some use for gardening when intensive management practices are possible. This soil can be built up by incorporating at least part of the peaty surface soil into the mineral soil and by the use of adequate amounts of fertilizers. Irrigation would appear to be a necessity for crop production in most seasons.

Jean Soil Series

The Jean is an Alluvial soil developed on clayey calcareous alluvial-lacustrine sediments. When forested it has a permanently frozen subsoil. It covers about 196,700 acres in the area between McConnell Island and Great Slave Lake. It is associated with the Grand Detour series, sloughs and wet marshes, and Nyarling peat. The Jean resembles the Slave series which does not have permafrost. The land pattern over most of the area is that of a gently undulating plain (Jean) with frequent small irregularly shaped meadows (Grand Detour), marshes and peat bogs, but in part of the area, lying adjacent to the Slave River, the land pattern is roughly parallel ridges (Jean) separated by meadows (Grand Detour) and sloughs. Natural drainage is imperfect and surface runoff is low. The native vegetation is chiefly spruce, birch, black poplar, and willow. Moss is the dominant constituent of the groundcover and shepherdia is common. The vegetation appears to be more dense and luxuriant than in areas without permafrost.

The Jean soil has the following general characteristics under forest. A moss and peat cover about eight inches thick is present. The dark brown mineral-organic clay loam under the moss is granular, friable and moderately calcareous. The subsoil is frozen at a depth of about 14 inches. The soil has high moisture-holding capacity.

A profile, examined on the southwest side of Slave River about two miles downstream from Jean River, has the following characteristics:

Horizon	Depth	
1	8 - 4"	Living sphagnum moss.
2	4 - 0"	Well-decomposed reddish brown mossy peat.
3	0 - 6"	Dark brown clay loam, moderately to highly calcareous, friable and usually exhibits bedding. There may be thin streaks of light colored sediment and charcoal fragments in this horizon.
4	6" +	Frozen mineral soil.

Some range in characteristics has been allowed. The depth of moss and peat ranges from four to 14 inches. The depth of permafrost depends on the thickness of the surface mat, the seasonal rainfall and temperature.

A burned-over member of the Jean soil has a fairly wide distribution. The thick moss cover has been replaced by a brown to reddish brown, highly calcareous sometimes gritty, clay loam. The burned soil surface is humpy and permafrost is deep or may even be absent.

A burned-over profile examined on the Slave River bank two miles downstream from the Jean River had the following characteristics:

Horizon	Depth	
1	0 - 3"	Brown to reddish brown (10 YR. 4/3 moist, 7.5 YR. 6/6 dry) gritty clay loam of weak fine nuciform structure, which contains bits of charcoal. Calcareous. Bulk density 0.76.
2	3 - 13"	Alternately banded, very dark gray and light brownish gray (10 YR. 3/1 and 6/2 dry) friable silty clay. Calcareous. Bulk density 0.50.
3	13 - 18"	Bedded silty clay as above, high in fibrous organic matter. Bulk density 0.46. Frozen below 18 inches.

A flooded profile of the Jean soil is common on the banks of the Slave River but probably occupies only a relatively small area.

A profile, sampled near the burned profile described above, has the following characteristics:

Horizon	Depth	
1	3 - 0"	Moss layer.
2	0 - 7"	Grayish brown (10 YR. 5/2 moist and dry) recently deposited friable clay loam. Many roots, slightly to moderately calcareous. Bulk density 0.53.
3	7 - 9"	Rotten brown wood.
4	9 - 19"	Alternately banded very dark brown and light gray (10 YR. 2/2 and 7/2 dry) silty clay. Non-calcareous. Bulk density 0.50. Frozen below 19 inches.

Suitability for Agriculture

The Jean series has a high soil moisture-holding capacity. The soil is moderately well supplied with organic matter and nitrogen and probably the supply of phosphorus is adequate for crop production. This soil should be suitable for the production of all crops suited to the area.

It was previously mentioned that the growth on the Jean series, as on the Resolution soils, is luxurious and dense. The reason for this lies in the presence of permafrost which impedes soil drainage. It has been observed that clearing off the natural vegetation as by burning has greatly lowered the depth of permafrost, perhaps causing it to disappear completely.

The results of thawing of the permafrost are twofold. The soil is much drier than under natural conditions. In the case of the Jean series, this is not too serious as the soil has good soil moisture-holding capacity. The other result is that ice blocks in the soil melt, causing subsidence of the surface. Areas which have been burned-over have humpy topography, although not so humpy as to seriously hinder cultivation.

The Jean soil series is classified as arable with some limitations. It is less desirable than the Slave series because of the more irregular topography and hazard of settling due to thawing of ice blocks, but it is capable of growing the same crops as the Slave series.

The difficulties, and hence costs of clearing on the Jean series, range from heavy clearing on the areas covered by forest to light on many parts of the burned-over areas.

Nyarling Peat

The Nyarling is a peat of sphagnum moss origin. It is distributed chiefly west of the Little Buffalo River and in the northern part of the Lowland. It is commonly found in association with Resolution and Jean soils and marshes. It covers 87,700 acres. The topography is level but the micro-topography is strong; in places the peat is five to six feet higher than adjacent marshes. Natural drainage is poor and surface runoff is low. The native vegetation is chiefly labrador tea and sphagnum moss with black spruce, tamarack, ground-birch, some willow and birch.

The profile has the following characteristics. Under a thick layer of living moss there is more than twelve inches of brown to reddish brown raw

fibrous sphagnum peat and woody remains. The depth to permafrost varies from eight to 24 inches but usually is found at 12 inches. The variation in depth of the peat is unknown.

Nyarling peat is unsuitable for agricultural purposes. The peat may be of some value as an amendment for other soils.

Miscellaneous Land Types

Recent Alluvium

The recent alluvium being deposited by the Slave River includes the shoals, bars, low terraces, and the bird's-foot delta at the mouth of the river. The alluvium is calcareous and ranges in texture from fine sandy loam to silty clay loam. It covers about 79,400 acres chiefly in the delta of the river but also occurs throughout the whole length of the river to Fort Smith. It is associated with the Jean and Slave series and with sloughs. Natural drainage is poor and surface runoff is low. It is subject to periodic or annual flooding. The native vegetation is chiefly willow, alder, dogwood, horsetail, and grasses. Black poplar occurs on the less frequently flooded areas. The lake shore, which is under water for a considerable portion of the year, is covered with rushes.

The soil profile shows some accumulation of organic matter and is limy throughout.

A profile, sampled north of Sawmill Channel near the lake shore, has the following characteristics:

Horizon	Depth	
1	1/2 - 0"	A very thin layer of grass, leaves, twigs from the previous year.
2	0 - 3"	Dark gray-brown (2.5 Y. 4/2 moist, 6/2 dry) fine sandy loam, very weak very fine granular and single grain structure. Bedding is visible when dry. Weakly to moderately limy. Bulk density 0.79, pH 7.3.
3	3 - 4"	Very dark brown (10 YR. 2/2 moist) fine sandy loam, moderately fine granular, friable, slightly to moderately limy, high in organic matter. Thought to be an old surface.

4	4 - 13"	Dark gray-brown (2.5 Y 4/2 moist, 6/2 dry) fine sandy loam and bands of very fine sandy loam of very dark gray-brown (2.5 Y. 3/2 moist) color. Single grained, friable and coherent. Weakly to moderately limy. Bulk density 1.19, pH 7.3.
5	13 - 24"	Very dark gray-brown (2.5 Y 3/2 moist, 6 2 dry) silty clay loam, and layers of dark gray-brown (2.5 Y. 4/3) sandy loam. Friable to hard when dry, coherent, weak fine granular structure. Olive yellow mottles (2.5 Y. 6/8 dry) are few, medium and faint. Bulk density 1.20, pH 7.5.

The most important variation is that of soil texture. The profile above was described in the delta area, while the most common texture in the terrace and bar section of the river is silty clay loam.

Suitability for Agriculture

While the recent alluvium is classed as non-arable due to the danger of flooding, particularly during the spring break-up, there are many small areas which could be cultivated and where garden crops could be grown with success. The moisture-holding capacity is fair to good, and good quality water for irrigation is available along the river banks. Chemical analyses (See Table V) show the recent alluvium to be low in nitrogen and organic matter, moderately low in available phosphorus, and medium high in total phosphorus.

Rough Stony Land and Rock Outcrops

This land type is of very limited occurrence. It covers only 4000 acres, located mostly along the shores of Great Slave Lake where outliers of Palaeozoic rock outcrop. Probably there are outcrops of Precambrian rocks along the eastern boundary of the area. The topography generally is moderately to strongly sloping or occasionally gently sloping. Soil drainage is good. The vegetation is sparse. Spruce and aspen are the common tree species. Flowers, shrubs and grasses present include red anemone, lyme grass, bluebell, Canada hawkweed, bearberry, Saskatoon berry, juniper, highbush cranberry, and gooseberry.

The soils are very thin where soil material is present. The parent material usually is extremely gravelly and stony glacial till overlain by sandy sediments. Nearly everywhere there are well-developed gravelly beaches containing limestones and a few granitic stones.

Eroded Land

This land type covers only 9000 acres in the area from Fort Smith north. It consists of the steeply sloping river banks of the Slave and Salt Rivers. The soil materials are very mixed and almost any vegetation common to the area may be found.

MAPPING ASSOCIATIONS

The scale of mapping required that the soil series and land types commonly found together be shown on the map as associations. Fifteen associations or mapping units, have been established. The associations and acreage of each are listed in Table III.

TABLE III

Mapping Associations in the Slave River Lowland

Association	Soils and Land Types	Percent	Acres
1	Fort Smith	95	25,000
	Norberta	5	
2	Norberta	75	99,000
	Fort Smith	25	
3	Clewi	90	6,000
	Fort Smith	10	
4	Grand Detour	95	219,300
	Slave	3	
	Slough and Marsh	2	
5	Grand Detour	60	806,000
	Slave	35	
	Marsh and Slough	5	
6	Grand Detour	30	36,000
	Norberta	30	
	Slave	35	
	Marsh	5	
7	Little Buffalo	70	18,000
	Slave	30	
8	Nyarling	50	51,000
	Slough and Marsh	45	
	Grand Detour	5	

Table III Cont'd.

Association	Soils and Land Types	Percent	Acres
9	Slave	40	195,000
	Grand Detour	40	
	Slough	15	
	Recent Alluvium	5	
10	Jean	50	354,000
	Grand Detour	30	
	Slough and Marsh	15	
	Nyarling	5	
11	Jean	40	12,000
	Grand Detour	40	
	Slough and Marsh	15	
	Recent Alluvium	5	
12	Resolution	45	149,000
	Jean	10	
	Nyarling	30	
	Slough	15	
13	Recent Alluvium		69,000
14	Rough Stony Land and Rock Outcrop		4,000
15	Eroded Land		9,000
	Lakes and Rivers		123,000
Total Acreage of the Lowland			2,179,000

The percentages of the different soils in each association are mean values for the entire association.

SOIL RATINGS

The soils of the Slave River Lowland differ in their relative potential value for agriculture. Some factors that determine the value are soil texture, soil moisture-holding capacity, natural fertility, natural soil structure, natural drainage, soil permeability, occurrence of permafrost, topography and flooding. On the basis of these characteristics the soil series and land types have been grouped into four classes of arability.

Class 1, arable

Soils in this class have the optimum combination of physical and chemical characteristics. They are naturally fertile, have good soil-moisture relationships and are expected to give good yields of all crops suitable to the area.

Class 2, arable with some or moderate limitations

These are fair to good arable soils but for general agriculture they are not quite so desirable as those of class 1 due to some limiting factor.

Class 3, arable with severe limitations

These are poor arable soils and for general agriculture they are undesirable due to critical limiting factors. They are very drouthy. However, they are useful for gardening where intensive cultivation, fertilization and irrigation is possible.

Class 4, non-arable

These soils and land types are considered to be non-arable. However, small areas may be found in them which would be suitable for gardening purposes.

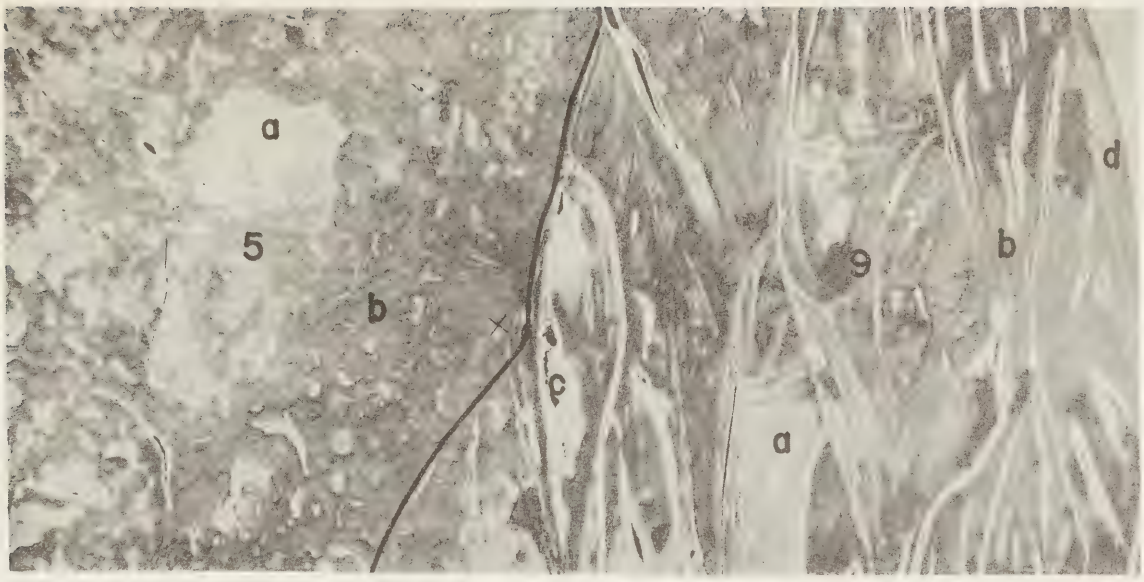
Such factors as the cost of clearing, accessibility, size of the soil series areas within an association, the nature of the associated soils and the land form have not been considered in the above rating. However, such factors greatly affect the desirability of land for agricultural purposes. Between Arability classes 1 and 2, these external factors probably are of greater importance in the selection of land than the soil ratings.

Fig. 1. In foreground sedges and grass on Grand Detour soil. In background aspen, spruce and willow on Little Baffalo soil.

Fig. 2. Willow invasion on Grand Detour soil in foreground. In background, spruce and aspen on Slave soil.

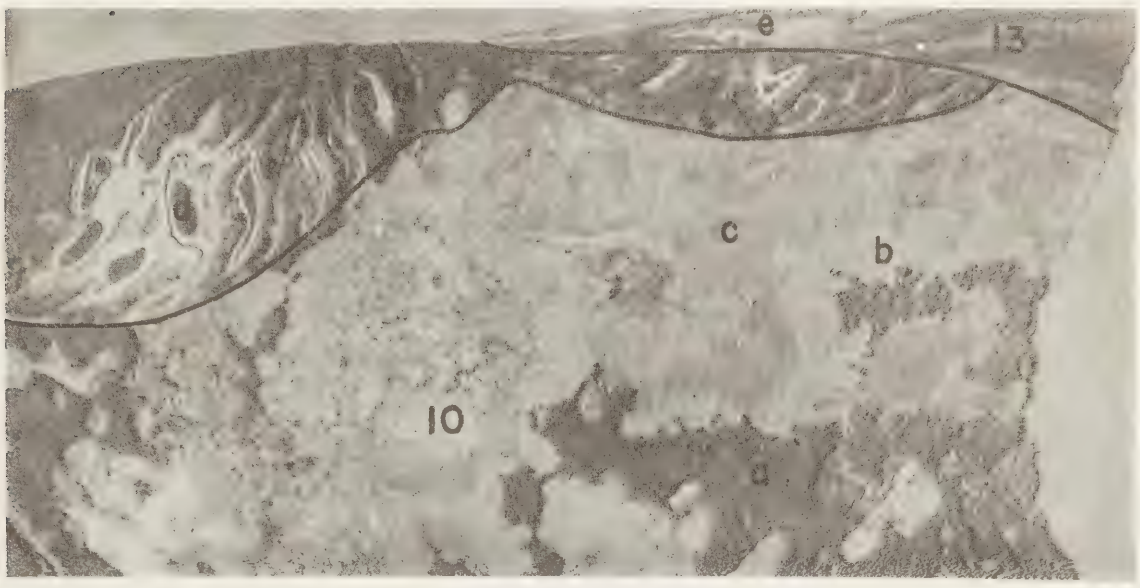
Fig. 3. Aspen, spruce and willow common to Little Buffalo and Slave soils.

Fig. 4. Gravelly beaches common to stony land and rock outcrops. Mission Island.



Courtesy Royal Canadian Air Force

Fig. 5. Aerial photograph showing soil associations 5 and 9. Association 5 is characterized by broad low ridges and meadows, association 9 by frequent, roughly parallel ridges and swales. The letters appearing on the photograph identify the surface appearance of examples of the soils and land types. a. Grand Detour soil, b. Slave soil, c. slough and marsh, d. recent alluvium.



Courtesy Royal Canadian Air Force

Fig. 6. Aerial photograph showing soil associations 10, 11 and 13. Association 10 is characterized by broad low ridges, knolls and meadows, association 11 by frequent roughly parallel ridges and swales, and association 13 by floodplains. The letters appearing on the photograph identify the surface appearance of examples of the soils and land types. a. Jean soil forested, b. Jean soil burned-over, c. Grand Detour soil, d. sloughs and marshes, e. recent alluvium. Note the scalloped river bank characteristic of eroding banks in the permafrost zone.

TABLE IV

Ratings of Soils, Acreage of Soil Series, and Acreage of Arability Classes in the Slave River Lowland

Rating	Soil or Land Type	Area of Series and Land Types		Limiting Factors	Area of Arability Classes	
		Acres	%		Acres	%
Class 1 – Arable	Little Buffalo	12,600	0.6	None	397,300	18.3
	Slave	384,700	17.7	None		
Class 2 – Arable with some or moderate limitations	Grand Detour	894,000	41.0	Imperfectly drained, slow to warm up, depressional topography	1,182,400	54.3
	Clewi	5,400	0.3	Tendency to drouthiness		
	Jean	196,700	9.0	Permafrost, tendency to humpy topography		
	Norberta	86,300	4.0	Poorly drained, slow to warm up, depressional topography, coarse texture		
Class 3 – Arable with severe limitations	Fort Smith	49,100	2.3	Low moisture-holding capacity, low organic matter and nitrogen	116,300	5.4
	Resolution	67,200	3.1	Low moisture-holding capacity, raw organic matter, permafrost		
Class 4 non-arable	Recent Alluvium	79,400	3.6	Subject to occasional flooding, poorly drained	356,000	16.2
	Nyarling	87,700	4.0	Raw sphagnum peat, high water table and permafrost		
	Slough and Marsh	175,900	8.0	Ponded		
	Rough stony land	4,000	0.2	Thin stony dry soils		
	Eroded Slopes	9,000	0.4	Steep slopes		
Lakes		4,000	0.2		127,000	5.8
Rivers		123,000	5.6			
	Total	2,179,000	100.0		2,179,000	100.0

Table IV shows that Classes 1 and 2, which are fair to good arable land, comprise about 73 percent of the Lowland, while Class 3 which is poor arable land, comprises about 5 percent. About 16 percent of the Lowland is non-arable land and 6 percent is water.

ANALYSES OF SOIL SAMPLES

Limited chemical and physical data on some of the soils are given in Table V. The chemical determinations were made by the Soil Chemistry Unit, Chemistry Division, Science Service, Canada Dept. of Agriculture. Texture was determined by the fieldman's method. Samples of most soil horizons were taken by means of a brass cylinder of 90 cc. capacity in order to determine bulk density. The chemical data are expressed in two ways; first on the usual basis of percentage by weight and second on the basis of grams per 100 cc. of soil.

The following abbreviations have been used in Table V.

B. D.	-	Bulk Density
O. M.	-	Organic Matter
N	-	Nitrogen
P	-	Phosphorus
S	-	Sand
SL	-	Sandy Loam
FSL	-	Fine Sandy Loam
L	-	Loam
SiCL	-	Silty Clay Loam
SiC	-	Silty Clay
Lt. CL	-	Light Clay Loam
CL	-	Clay Loam
C	-	Clay
P	-	Peat
M	-	Muck
N. D.	-	Not Determined

Some comments on the significance of the data in Table V from the viewpoint of crop production are given below.

pH: The intensity of soil acidity or alkalinity is expressed in pH. A pH of 7.0 is neutral; lower values indicate acidity and higher values alkalinity. The desirable range for cultivated soils in Northern Canada is from moderately acid, pH 5.6, to slightly alkaline, pH 7.8. All the samples analyzed, with two exceptions, would on cultivation have surface soils falling within this pH range. The Fort Smith soil, and possibly the Slave soil, would probably be

below the range. However, these figures were obtained on virgin samples and it has been noted that when cultivated, similar soils become less acidic.

Bulk Density: (B.D.) Bulk density, or the weight of soil per unit volume, is necessary in order that the amounts of chemical elements may be expressed on the volume of soil. Since the various horizons of a soil profile may vary widely in the weight of soil per unit volume, a much better comparison of the amount of plant food in the various horizons within each profile and between different soils is given by the amount of an element in grams per 100 cubic centimeters of soil than does the amount expressed as grams per 100 grams of soil. This is especially true when comparing organic and mineral soils.

Organic Matter and Nitrogen

The Alluvial soils are well supplied with organic matter and nitrogen, while the Brown Wooded soils are poorly supplied. The Grand Detour has the highest levels with a favorable carbon-nitrogen ratio and should not require application of nitrogen for a long time. The Little Buffalo soil is nearly as well supplied as Grand Detour but the Slave soil is only moderately well supplied and would probably require nitrogen fertilizer within a few years of being cultivated. The recent alluvium, Clewi and Fort Smith soils are poorly supplied and probably will require nitrogen fertilizer after clearing and cultivation.

Phosphorus

The soils of the surveyed area have in general about the same content of total phosphorus as the soils in the Great Plains sections of the Prairie Provinces. These soils may not require applications of phosphatic fertilizers until they have been cropped for several years.

The content of "available" phosphorus is variable and in general is highest in the surface horizons. At present there are very few data for similar soils on available phosphorus as related to crop response. However, it is expected that the Slave soil and the recent alluvium may be deficient in available phosphorus.

TABLE V

Analyses of Soil Samples Collected in the Slave River Lowland

HORIZON	DEPTH INCHES	TEXTURE	pH	B. D.	O. M. %	N %	TOTAL P %	AVAILABLE[3] P ppm	GRAMS PER 100 cc OF SOIL			C/N
									OM	N	Total P	
	Data expressed on air-dry basis											
Fort Smith series sampled near mission in Fort Smith[1]												
1	2-0	O.M.	6.5	N. D.	29.5[2]	0.59	0.05	N. D.	N. D.	N. D.	N. D.	29.0
2	0-6	SL	5.2	N. D.	1.6[2]	0.04	0.04	N. D.	N. D.	N. D.	N. D.	23.2
3	6-22	S	6.7	N. D.	1.4[2]	0.02	0.05	N. D.	N. D.	N. D.	N. D.	40.6
4	22-34	S	7.0	N. D.	1.3[2]	0.02	0.05	N. D.	N. D.	N. D.	N. D.	37.7
Alkaline Thin Black soil sampled on old road north of Salt River, variant of Norberta series												
1	0-4	SL	6.5	0.89	10.8	0.51	0.08	33.3	9.6	0.45	0.07	12.3
2	4-20	SL	8.4	1.34	0.7	0.06	0.07	5.1	0.9	0.08	0.09	5.9
3	20-	FSL	8.3	1.47	0.6	0.04	0.07	3.3	0.9	0.06	0.10	8.7
Clewi series sampled on old road north of Salt River												
2	0-2	L	7.0	N.D.	28.5	1.01	0.20	119.6	N.D.	N.D.	N.D.	16.4
3	2-8	SiCL	5.9	1.13	1.5	0.09	0.07	42.0	1.7	0.10	0.07	9.8
4	8-23	SiCL	6.0	1.15	1.0	0.06	0.08	21.8	1.1	0.07	0.09	9.7
5	23-28	SiCL	7.3	1.18	1.6	0.07	0.08	18.6	1.8	0.08	0.09	13.2
6	28-	S	8.0	N.D.	0.2	0.03	0.06	0.6	N.D.	N.D.	N.D.	3.9
Grand Detour series sampled on portage trail to Little Buffalo River												
1	12-4	P	5.5	0.42	90.0	3.04	0.10	28.5	37.8	1.28	0.04	17.2
2	4-0	M	5.8	0.27	53.8	1.97	0.07	4.6	14.5	0.53	0.02	15.9
3	0-8	SiC	6.0	0.89	9.4	0.43	0.03	N.D.	8.4	0.38	0.03	12.7
4	8-16	SiC	5.4	0.64	26.1	1.03	0.04	2.7	16.7	0.66	0.02	14.7
5	16-	CL	7.6	N.D.	7.1	0.32	0.04	6.8	N.D.	N.D.	N.D.	12.7

TABLE V (Cont'd)

HORIZON	DEPTH INCHES	TEXTURE	pH	B.D.	O.M. %	N %	TOTAL P %	AVAILABLE P[3] ppm	GRAMS PER 100 cc OF SOIL			C/N
									OM	N	Total P	
Grand Detour series sampled east of Long Island (burned over)												
1	3-0	P	6.3	0.13	69.8	2.43	0.13	37.2	9.0	3.16	0.02	16.7
2	0-3	C	7.2	0.40	26.3	1.30	0.11	13.7	10.5	0.52	0.04	11.8
3	3-5	C	7.8	N.D.	5.6	0.37	0.08	6.2	N.D.	N.D.	N.D.	8.8
4	5-	C	7.6	0.93	7.5	0.48	0.10	8.2	0.7	0.45	0.09	9.1
Grand Detour series sampled east of the Junction of Nyarling and Little Buffalo Rivers												
1	5-0	M	6.3	N.D.	29.7	1.66	0.11	8.3	N.D.	N.D.	N.D.	10.4
2	0-10	SiC	7.8	N.D.	3.3	0.15	0.04	1.1	N.D.	N.D.	N.D.	12.8
3	10-	SiCL	7.6	N.D.	1.2	0.06	0.06	4.8	N.D.	N.D.	N.D.	11.6
Slave series sampled near Portage Island on Slave River bank												
2	0-4	C	5.0	0.89	7.7	0.29	0.06	9.9	6.3	0.26	0.05	15.4
3	4-10	C	6.1	0.89	4.4	0.21	0.06	8.1	3.9	0.19	0.06	12.2
4	10-18	C	7.3	1.00	3.1	0.16	0.07	6.7	3.1	0.16	0.07	11.3
6	20-26	SiC	7.6	1.36	1.3	0.07	0.08	2.9	1.8	0.10	0.10	10.8
7	26-	SiC	7.8	N.D.	1.1	0.05	0.07	2.0	N.D.	N.D.	N.D.	12.7
Slave series sampled on Long Island												
2	2-0	O.M.	5.0	N.D.	35.6	0.79	0.06	6.6	N.D.	N.D.	N.D.	26.1
3	0-8	SiCL	6.1	0.52	16.8	0.45	0.07	13.2	8.7	0.23	0.04	21.6
4	8-20	SiCL	6.6	0.81	9.8	0.29	0.07	12.0	7.9	0.24	0.06	19.6
Slave series sampled at Brule Point[1]												
2	0-8	C	6.4	N.D.	14.7[2]	0.36	0.06	N.D.	N.D.	N.D.	N.D.	23.7
3	8-14	C	6.6	N.D.	10.6[2]	0.26	0.06	N.D.	N.D.	N.D.	N.D.	22.6
4	14-19	C	7.5	N.D.	8.9[2]	0.17	0.09	N.D.	N.D.	N.D.	N.D.	30.4
5	19-23	C	8.0	N.D.	8.7[2]	0.20	0.09	N.D.	N.D.	N.D.	N.D.	25.2

TABLE V (Cont'd)

HORIZON	DEPTH INCHES	TEXTURE	pH	B. D.	O. M. %	N %	TOTAL P %	AVAILABLE P[3] ppm	GRAMS PER 100 cc OF SOIL			C/N
									OM	N	Total P	
Little Buffalo Series sampled near lower rapids on Little Buffalo River												
2	0-6	L	6.3	0.36	18.5	0.61	0.10	50.2	6.6	0.22	0.04	17.6
3	6-12	Lt.CL	6.9	0.69	13.0	0.48	0.09	25.6	9.0	0.32	0.07	15.7
4	12-18	Lt.CL	7.2	0.61	15.0	0.68	0.11	29.3	9.1	0.41	0.06	12.8
6	20-26	SiC	7.3	0.87	6.4	0.23	0.07	11.4	5.6	0.20	0.06	16.1
Resolution series sampled 3 miles south of Little Buffalo River mouth												
1	7-3	P	6.2	N.D.	66.4	1.27	0.09	85.2	N.D.	N.D.	N.D.	30.3
2	3-0	P	7.5	N.D.	9.5	1.16	0.14	35.8	N.D.	N.D.	N.D.	4.8
3	0-2	SL	7.4	N.D.	5.2	0.16	0.06	8.1	N.D.	N.D.	N.D.	18.9
4	2-	S	7.6	N.D.	1.1	0.04	0.06	4.4	N.D.	N.D.	N.D.	16.0
Recent Alluvium sampled on Slave River delta near the Slave River mouth												
2	0-3	FSL	7.3	0.79	3.8	0.17	0.08	11.7	3.0	0.13	0.06	13.0
4	4-13	FSL	7.3	1.19	1.7	0.07	0.07	5.1	2.0	0.08	0.09	14.1
5	13-24	SiCL-SL	7.5	1.20	1.7	0.08	0.07	4.3	2.0	0.10	0.09	12.3

1. This sample was collected by Leahey in 1945.
2. This value determined by loss on ignition 850°.
3. By the $NaHCO_3$ method of Olsen et al.

SUITABILITY OF WATER FOR IRRIGATION

Sources of irrigation water generally are not plentiful except adjacent to the Slave River. Slough water in the Lowland is apparently of suitable quality but the sloughs generally are small and in many parts rather far apart. Slave River water is apparently of suitable quality for irrigation but the silt content is moderately high and the possibility exists of irrigation ditches becoming partially filled with silt.

Since the waters of the Little Buffalo and the Salt Rivers were noticeably saline, samples of these waters were collected for chemical analyses. The sample from the Little Buffalo River was collected near its mouth on July 13, and the sample from the Salt River was collected about four miles from its mouth on August 13. Table VI contains the results of the analyses.

TABLE VI

Chemical Properties of Water from Slave River Lowland

Constituent	Little Buffalo River	Salt River
Sodium	160 ppm	2660 ppm
Calcium	429 ppm	540 ppm
Magnesium	60 ppm	56 ppm
Chlorides	275 ppm	4076 ppm
Sulfates	1069 ppm	1399 ppm
Total Hardness ppm $CaCO_3$	945 ppm	1185 ppm
Total Solids	0.29%	1.34%
Equivalent Conductivity EC X 10^6, by meter	-	12,400 m.mhos.
Equivalent Conductivity by calculation	3300 m.mhos.	12,400 m.mhos.
Sodium-adsorption-Ratio	1.9	28.0

The Little Buffalo River water would be classified as* "very high in salinity hazard and as low in sodium hazard. This classification means that the water is not suitable for irrigation under ordinary conditions, but may be used occasionally under very special circumstances. The soils must be permeable, drainage adequate, irrigation water must be applied in excess to

* U. S. Salinity Laboratory Staff, "Diagnosis and Improvement of Saline and Alkali Soils". Agriculture Handbook 60, U.S.D.A. 1954.

provide considerable leaching, and very salt-tolerant crops should be selected. The danger of causing poor soil structure by sodium saturation is remote". Thus this water is of only very limited value for irrigation.

The Salt River water would be classified *as "very high in salinity hazard and very high in sodium hazard". This particular water is unsuitable for irrigation under any circumstances.

A Partial List of Vegetative Species in the Slave River Lowland

Trees

Alder	Alnus tenuifolia Nutt.
Aspen	Populus tremuloides
Birch	Betula papyrifera
Black poplar	Populus balsamifera L.
Black spruce	Picea mariana
Pine	Pinus banksiana Lamb.
Spruce	Picea glauca
Tamarack	Larix laricina (DuRoi) Koch
Willow	Salix interior Rowlee var. pedicellata (Anders.) Ball
	Salix arbusculoides Anders.
	Salix pseudomonticola Ball

Shrubs, Forbs & Grasses

Alkali grass	Puccinellia airoides (Nutt.) Wats. & Coult.
Avens	Geum perincisum Rydb.
Baltic rush	Juncus balticus Willd. var. littoralis Engelm.
Bearberry	Arctostaphylos uva-ursi (L.) Spreng.
Bluebell	Campanula rotundifolia L.
Canada hawkweed	Hieracium canadense Michx.
Contracted reed grass	Calamagrostis inexpansa Gray
Dog couch grass	Agropyron trachycaulum (Link) Malte
Foxtail	Hordeum jubatum L.
Glasswort	Salicornia rubra Nels.
Gooseberry	Ribes oxyacanthoides L.

* U. S. Salinity Laboratory Staff, "Diagnosis and Improvement of Saline and Alkali Soils". Agriculture Handbook 60, U.S.D.A. 1954.

Shrubs, Forbs & Grasses (cont'd)

Ground birch	Betula glandulosa
Highbush cranberry	Viburnum edule (Michx.) Raf.
Horsetail	Equisetum arvense L.
Juniper	Juniperus communis L. var. depressa Pursh
Lyme grass	Elymus innovatus Beal
Labrador tea	Ledum groenlandicum
Mint	Mentha arvensis L. var. villosa (Benth.) Stewart forma glabrata (Benth.)Stewart
Marsh hedge nettle	Stachys palustris L. var. pilosa (Nutt.) Fern.
Moss	Lycopodium spp.
Red anemone	Anemone multifida Poir. var. hudsoniana DC.
Red osier dogwood	Cornus stolonifera Michx.
Saskatoon berry	Amelanchier alnifolia Nutt.
Shepherdia or soap berry	Shepherdia canadensis (L.) Nutt.
Sedge	Carex atherodes Spreng.
Silver berry	Elaeagnus commutata Bernh.
Silverweed	Potentilla anserina L. sl.
Shrubby cinquefoil	Potentilla fruticosa L.
Sprangle-top	Scolochloa festucacea (Willd.) Link

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QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1957